Amendments to the Drawings:

The attached sheet of drawings includes changes to Figs. 24 and 25. This sheet, which includes Figs. 23, 24 and 25, replaces the original sheet containing Figs. 23, 24 and 25.

In Fig. 24, all of the second line, i.e., T_2 has been deleted.

In Fig. 25, all of the second and third lines were deleted, i.e., T_2 and T_3.

Attachment: Replacement Sheet

Annotated Sheet Showing Changes

REMARKS

The Examiner is respectfully requested to approve the drawing, including the replacement drawings for FIGS. 24 and 25 submitted concomitantly herewith.

The specification was objected to under 35 USC 112, first paragraph, for the reasons set forth in item no. 1 at the top of page 2 o the Office Action.

An amendment was made to page 33 (changing "magnetic poles 28" to -- iron cores 22--) of the specification to avoid the aforesaid objection. It is considered that said amendment is an obvious correction of an obvious error, since the magnetic field generating device comprises a coil and an iron core. A pair of iron cores are depicted in applicants' Fig. 20.

Withdrawal of the objection to the specification is respectfully requested.

With respect to the above amendment to claim 1 involving "comprising a step of feeding molten steel into a mold thereby solidification of the molten steel proceeds," please see "feeding molten steel to a mold" on page 10, line 9 of the specification. As for the terminology of the "solidification of the molten steel

proceeds" that was added to claim 1, the terms "solidification interface" and "solidification nucleus" are described in line 2 and line 6 of page 10 of the specification.

The definition of "longitudinal direction" as recited in amended claim 1 is in accordance with the suggestion by the Examiner in item no. 2 on page 2 of the Office Action. The longitudinal direction is defined as b in FIG. 2 (see page 13, line 5 of the specification).

The explanation of "vibrating magnetic field" in amended claim 1 is based upon the explanation on page 21, lines 3 to 9 of the specification. Further, the amendment is clear from applicants' FIG. 30, in which the Lorentz forces of the adjacent magnetic poles are reversed to each other at a certain phase (e.g., 22.5° or 202.5°, in the enclosed marked-up copy of applicants' FIG. 30 entitled "Reference draft").

The arrangement of 0, n, 2n and n in amended claim 2 is disclosed in applicants' FIG. 17.

Claim 4 was canceled hereinabove. Claims 5, 6, 11 to 15, 22 and 26 were amended in view of the cancellation of claim 4.

Claim 11 was amended to include the features of original claim 5.

Claims 12 and 13 were amended to include the features of original claim 6.

Claims 1 to 27 were rejected under 35 USC 112, second paragraph, for the reason indicated in item no. 2 at the middle of page 2 of the Office Action.

As discussed above, claim 2 was amended by following the Examiner's suggestion.

Withdrawal of the 35 USC 112, second paragraph rejection is respectfully requested.

The presently claimed invention is directed to a continuous steel casting method comprising feeding molten steel into a mold, whereby solidification of the molten steel proceeds, and

controlling a flow of unsolidified molten steel in the mold by applying a vibrating magnetic field which is generated with an arrangement of at least three electromagnets disposed along a longitudinal direction of the mold, peak positions of the vibrating magnetic field are shifted along the longitudinal direction, wherein the longitudinal direction of the mold is a direction along the side face of the mold, wherein the vibrating magnetic field comprises a magnetic field in which the direction of an electromagnetic force acting on the molten steel between a

pair of two adjacent electromagnets is substantially opposite to that of the electromagnetic force acting on the molten steel between the adjacent pair of electromagnets.

Claims 1 to 3, 8 to 10, 20, 21, 24 and 25 were rejected under 35 USC 103 as being unpatentable over EP 972 591 for the reasons set forth in item no. 5 on pages 3 to 4 of the Office Action.

Claims 4 to 7, 11 to 19, 22, 23, 26 and 27 were rejected under 35 USC 103 as being unpatentable over EP 972 591 and further in view of USP 6,117,389 to Nabeshima et al. for the reasons set forth in item no. 6 on page 4 of the Office Action.

In the "vibrating magnetic field" ([0011] indicated by the Examiner) disclosed in EP 972591, the electromagnetic forces in the same direction are applied on the molten steel along the longitudinal direction of the mold at a certain moment, as is clear from the paragraph number [0013] and FIG. 1 of this cited document. Specifically, in the magnetic field in EP 972591, only the directions of the electromagnetic forces are alternately reversed with time, and the directions of the electromagnetic forces are not alternately reversed depending upon the position of the mold in the longitudinal direction.

On the other hand, with regard to the vibrating magnetic field, according to applicants' present claims, the magnetic field including the relationship in which the electromagnetic force (i.e., Lorentz force) applied between certain two magnetic poles and the electromagnetic force applied to two magnetic poles that are adjacent to between the magnetic poles are reversed with respect to each other. The term "vibrating magnetic field" is used, as the same meaning, in the second paragraph in page 11 of the present specification as pointed out by the Examiner, and further, it is described in the last two sentences in the same paragraph that the phase difference between the adjacent electromagnets is set to set to be 180° or more in order to produce a vibrating magnetic field.

Applicants' present claims thus represent an improvement of the above-mentioned vibrating magnetic field, and hence, it is not the one in which the phases difference between the electromagnets are symmetrically reversed (accordingly, applicants' present claims do not need the requirement of the phase difference being 180° or more). Basically, applicants' present claims have, as one characteristic of the magnetic field, the reversal of the direction of the electromagnetic forces

depending upon the position of the longitudinal direction of the mold.

The difference among a shifting magnetic field (general technique), a vibrating magnetic field (defined in the specification of the subject application) and as "vibrating magnetic field in which a peak position is shifted" (recited in applicants' present claims) will be explained in detail below with reference to the examples in the present specification.

Shifting magnetic field: FIG. 15 in the subject application illustrates the arrangement of magnetic poles producing a shifting magnetic field. This is further simplified and illustrated below. In this example, the phases difference allocated to the magnetic poles A to D are set to 0, n, 2n, and 3n, with n = 90°. In this example, all of the phases differences between a certain magnetic pole and the magnetic pole adjacent to the magnetic pole at the right side are all n, and hence, the electromagnetic force a of the same direction (in the rightward direction here) is applied between each magnetic pole. The shifting magnetic field is a conventional basic technique, and it is difficult to cause a strong local stir at the interface of the solidification by this technique (when the electromagnetic force

is excessively increased, the entrainment of mold powders due to a macroscopic flow is caused).

Vibrating magnetic field (basic form): FIG. 16 in the subject application illustrates the arrangement of magnetic poles producing a vibrating magnetic field. This is further simplified and illustrated below. In this arrangement, 0 and 2n are repeated with n = 90°. Since the phase differences between a certain magnetic pole and the magnetic pole adjacent to the magnetic pole at the right side are reversed such as 2n and -2n, the electromagnetic forces b1 and b2 in the reverse direction are applied respectively between the magnetic poles A and B and the magnetic poles B and C as for the Lorentz force. The basic vibrating magnetic field is excellent in the stirring force, but the area X where the stirring force is not so applied is present as is understood from the attached marked-up copy of applicants' FIG. 30 (see page 18, lines 8 to 18 of the present specification).

Vibrating magnetic field in which peak position is shifted: Figs. 17 and 18 of the subject application illustrate the arrangement of the magnetic poles for producing the vibrating magnetic field in which the peak position is shifted. This is further simplified and illustrated below.

In this example, the phases allocated to the magnetic poles A to D are set to 0, n, 2n and n with n = 90°. Among the magnetic poles A to C, the rightward electromagnetic forces c1 and c2 are successively applied in accordance with the phase difference n, while the leftward electromagnetic force c3 is applied between the magnetic poles C to D, since the phase difference is -n. However, different from the basic vibrating magnetic field, the rightward electromagnetic force and the leftward electromagnetic force are not equal to each other, whereby the peak position of the vibration is not determined to be one position, but shifted rightward where a stronger force is applied as a whole. Therefore, the portion where the stirring force is weak (the valley between the peaks) is also not fixed but shifted, so that a strong stirring force is applied to the whole surface of the mold in the longitudinal direction.

In the example of FIG. 18, the phases difference allocated to the magnetic poles A to C are set to n, 3n and 2n with n = 60°. Between the magnetic poles A and B, the rightward electromagnetic force d1 is applied in accordance with the phase difference 2n, while the leftward electromagnetic force d2 is applied in accordance with the phase difference -n between the

magnetic poles B and C. In this case, the electromagnetic force of d1 is greater than the electromagnetic force d2, since the phase difference 2n is greater than the phase difference -n. Therefore, in this example too, the rightward electromagnetic force and the leftward electromagnetic force are not equal to each other, so that the peak position of the vibration is shifted rightward.

The excellent effect of the vibrating magnetic field in which the peak position is shifted according to the invention of the subject application is described, for example, in the third embodiment (the patterns A and B are the examples illustrated above, the pattern C is the shifting magnetic field, and the pattern D is the basic vibrating magnetic field). Specifically, as apparent from Table 1 on page 48 of the present specification, the example of the present invention surpasses the shifting magnetic field and the basic vibrating magnetic field in that the example of the present invention prevents the entrainment of mold flux (i.e., it does not induce excessive macroscopic flow of a molten steel), and avoids the entrapment of air bubbles and inclusion in the slab (i.e., it applies a strong local stirring to the molten steel).

EP 972591 describes the technique of reversing the direction of the electromagnetic force with time by using the shifting magnetic field, which is excellent in the stirring force compared to the conventional shifting magnetic field. However, applicants' presently claimed invention of the subject application, in which the electromagnetic forces of different directions are simultaneously applied, is more excellent in the stirring force, since it induces a complicated local flow to the molten steel.

EP 972591 and US 6,117,389 do not disclose the vibrating magnetic field indicated in the invention of the subject application.

Withdrawal of each of the rejections under 35 USC 103 is therefore respectfully requested.

Claims 1 to 27 were rejected under 35 USC 102(f) for the reasons stated in item no. 8 at the top of page 5 of the Office Action, wherein it was alleged that the applicants did not invent the claimed subject matter.

The Office Action referred to JP 2004-58092; JP 2003-103348 and JP 2003-10349.

JP 2004-58092, JP 2003-103348 and JP 2003-103349 are all the inventions made by Yuji MIKI and Shuji TAKEUCHI. Accordingly, the invention of the subject application is not an invention made by others.

This misunderstanding may have arose due to an error in the information given by the Japanese Patent Office that the first name of Mr. TAKEUCHI is written as "Hideji" in the above-mentioned documents. That is, the Japanese Patent Office identifies the name of the invention in Kanji, and the Japanese Patent Office does not generally require of the applicant correct information about its pronunciation (alphabetical notation). Therefore, the English translation of the name of the inventor made by the Japanese Patent Office is not always correct. It is clear from the following that the name Hideji TAKEUCHI should be Shuji TAKEUCHI.

The name of Mr. TAKEUCHI with Kanji notation is the same in JP 2004-58092, JP 2003-103348, JP 2003-103349 and PCT publication of the subject application, the front pages of all of which are attached.

The first name of the inventor TAKEUCHI of the basic Japanese applications (Japanese Patent Application No. 2003-

108344 and Japanese Patent application No. 2003-117340) of the subject application was erroneously listed as Hideji TAKEUCHI by the Japanese Patent Office (the English abstract of which is attached). The front page of these applications are also attached in order to indicate the same error with respect to the Kanji listing of Mr. TAKEUCHI's first name.

Applicants have informed the undersigned that the inventors of the present claims of the subject application are as follows:

Claims (amended) 1 to 7, 10 to 19: Yuji MIKI and Shuji TAKEUCHI.

Claims (amended) 8, 9, 20 to 27: Yuji MIKI, Shuji TAKEUCHI and Akira YAMAUCHI.

The above-mentioned JP 2004-58092, JP 2003-103348 and JP 2003-103349 do not describe the invention of applicants' claims (amended) 8, 9 and 20 to 27. Therefore, there is no inconsistency with respect to Akira YAMAUCHI being a listed inventor of the above-identified application.

JP 2003-103348 and JP 2003-103349 describe a technique relating to a basic vibrating magnetic field. Therefore, the techniques disclosed in JP 2003-103348 and JP 2003-103349 are not the vibrating magnetic field in which the peak position is

shifted, and hence, they are different inventions from the invention of applicants' present claims. JP 2004-58092 corresponds to the original claims 1 to 3 of the subject application. Japanese Patent Application No. 2003-108344 that is the basis of the priority corresponds to the original claims 4 to 7, and the Japanese Patent Application No. 2003-117340 corresponds to the original claims 8 and 9.

Withdrawal of the 35 USC 102(f) rejection is thus respectfully requested.

Applicants have informed the undersigned that the phase difference of the T_2 cycle in FIG. 24 and the phase differences of the T_2 and T_3 cycles in FIG. 25 contain erroneous numerical values (the amounts of change in the phase differences with time do not agree with each other between magnetic poles). In view of the above, FIGS. 24 and 25 were amended to delete T_2 in FIG. 24 and to delete T_2 and T_3 in FIG. 25.

Reconsideration is requested. Allowance is solicited.

If the Examiner has any comments, questions, objections or recommendations, the Examiner is invited to telephone the undersigned at the telephone number given below for prompt action.

Respectfully submitted,

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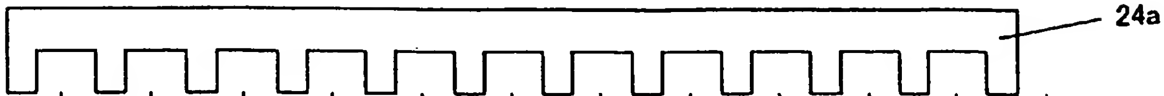
RSB/ddf

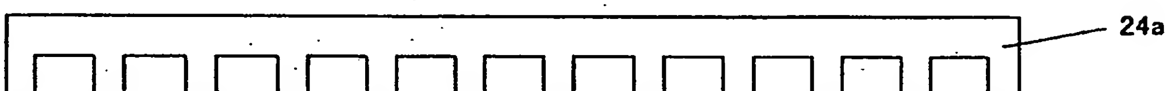
Encs.: (1) PETITION FOR EXTENSION OF TIME
(2) Marked up copy of applicants' FIG. 30 entitled "Reference draft"
(3) Front pages of JP 2004-58092, JP 2003-103348, JP 2003-103349, WO 2004/091829, JP 2004-314096, JP 2004-322120
(4) English-language abstracts of JP 2004-314096 and JP 2004-322120
(5) English-language translations of the application data for JP 2004-314096 and JP 2004-322120

Fig. 23



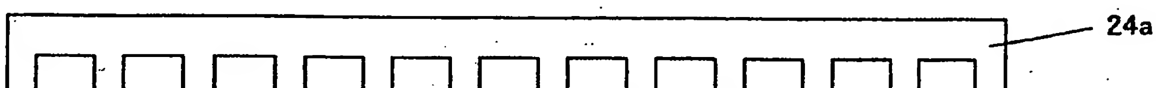
T_1	0	90	180	270	0	90	180	270	0	90	180	270
T_2	90	180	270	0	90	180	270	0	90	180	270	0
T_3	180	270	0	90	180	270	0	90	180	270	0	90
T_4	270	0	90	180	270	0	90	180	270	0	90	180

Fig. 24



T_1	0	90	180	90	0	90	180	90	0	90	180	90
~~T2~~	~~90~~	~~180~~	~~90~~	~~0~~	~~90~~	~~180~~	~~90~~	~~0~~	~~90~~	~~180~~	~~90~~	~~0~~

Fig. 25



T_1	60	180	120	60	180	120	60	180	120	60	180	120
~~T2~~	~~180~~	~~120~~	~~60~~	~~180~~	~~120~~	~~60~~	~~180~~	~~120~~	~~60~~	~~180~~	~~120~~	~~60~~
~~T3~~	~~120~~	~~60~~	~~180~~	~~120~~	~~60~~	~~180~~	~~120~~	~~60~~	~~180~~	~~120~~	~~60~~	~~180~~

Reference draft

参考図

Fig. 30

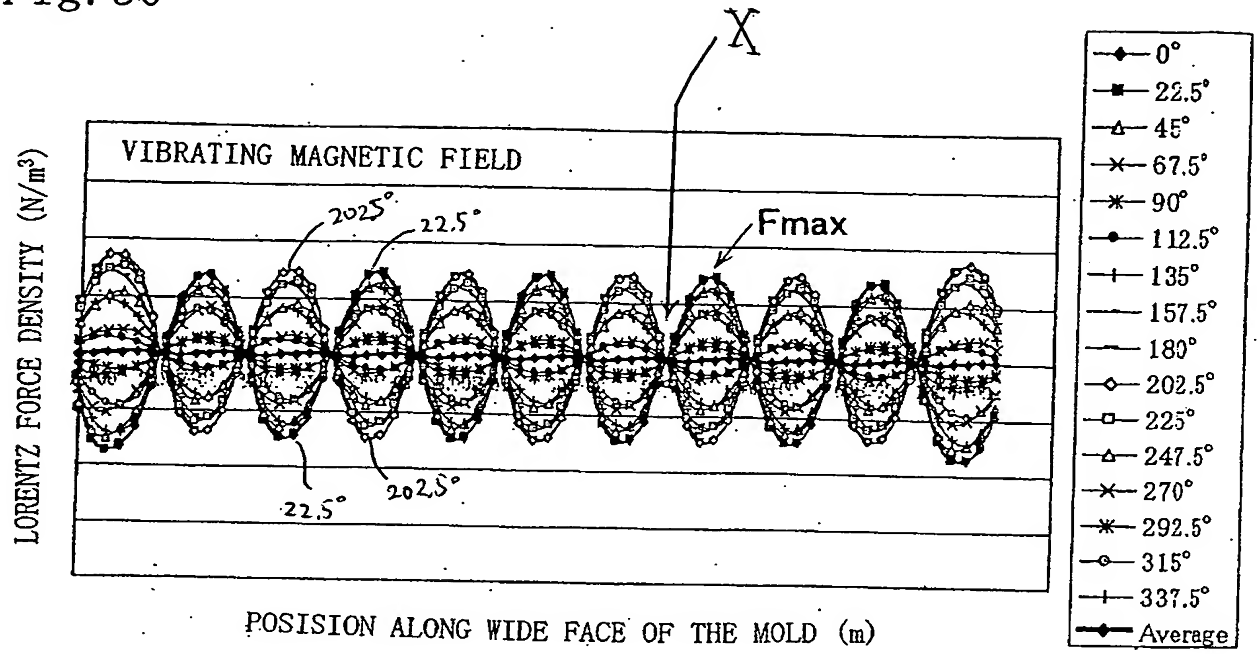
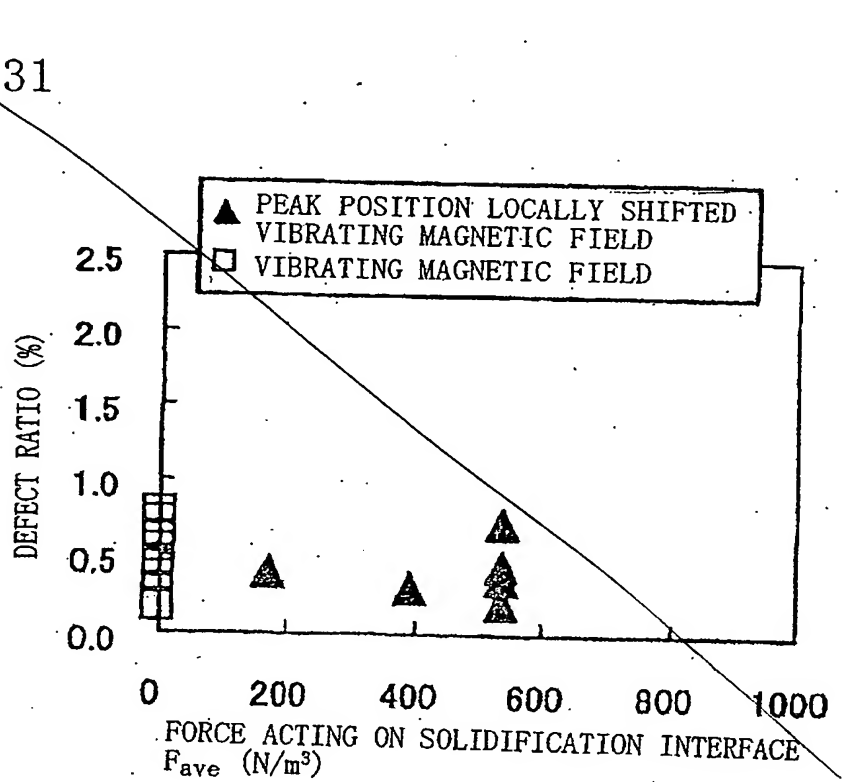


Fig. 31



審査官引用

15/23

JP 2004-58092 A 2004. 2. 26

(19) 日本国特許庁(JP)

(12) 公開特許公報(A)

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B22D 11/04	B22D 11/04	311J	
B22D 11/115	B22D 11/115	B	

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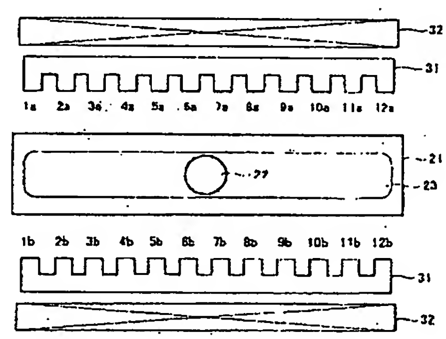
Fターム(参考) 4E004 AA09 MB11 MB12

(54)【発明の名称】鋼の連続鋳造方法

(57)【要約】
【課題】近年の表面品質ニーズの高まり、コストダウンの要求から、更なる鋳片表面の品質改善技術が望まれており、より効果的な鋳型内流動の制御を実現する鋳型内流動制御技術を提供する。
【解決手段】連続鋳造用鋳型21の鋳型長辺方向に沿って3個以上のコイル1a～12a、1b～12bを並べた電磁石31を配置し、この電磁石に振動磁界を発生させながら振動磁界のピーク位置を鋳型21の長辺方向に沿って移動させる。また、直流コイル32で直流磁界をこれに重畳する。
【選択図】 図1



12/7/07, EAST Version: 2.1.0.14

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			C
11/04	311	11/04	311J

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(33)優先権主張国　日本（ＪＰ）

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(33)優先権主張国　日本（ＪＰ）

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弁理士　高矢　諭　（外2名）

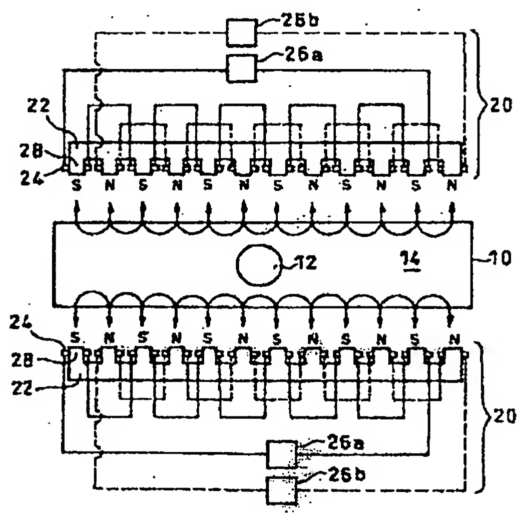
Fターム(参考)　4E004 AA09 MB11 MB12 NB01 NC01

(54)【発明の名称】　鋼の連続鋳造方法及び設備

(57)【要約】

【課題】　捕捉される気泡、非金属介在物及び鋳片表面偏析、モールドフラックス起因の表面欠陥や内部介在物の少ない鋳片を鋳造して、高品質の金属製品の製造を可能とする。

【解決手段】　鋳型10の長辺方向に3個以上の電磁石（28）を配置し、隣り同士のコイル24で発生する磁場を実質反転させることで、溶鋼に位相が実質反転する振動電磁界を作用させ、電磁力によって凝固核前面のデンドライトの破断を引き起こすことなく、局所的な流動を励起させる。



19

(19)日本国特許庁（ＪＰ）　(12) 公開特許公報（Ａ）　(11)特許出願公開番号
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（P2003－103349A）
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			C	
11/04	311	11/04	311J	
11/11		11/11	D	

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(33)優先権主張国　日本（ＪＰ）
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(33)優先権主張国　日本（ＪＰ）

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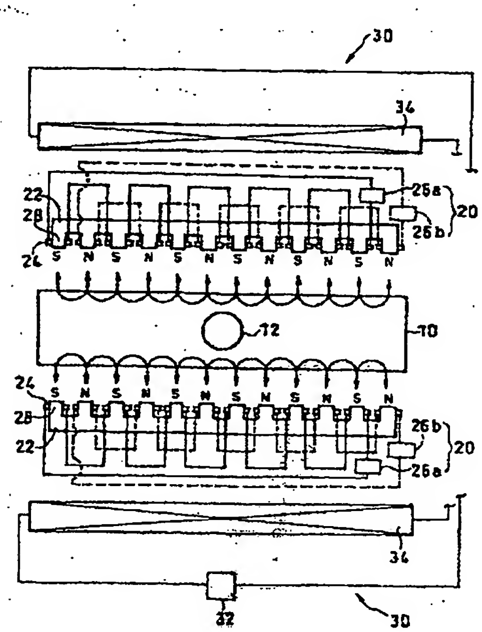
弁理士　高矢　諭　（外2名）

Fターム(参考)　4E004 AA09 MB11 MB12 NB01 NC01

(54)【発明の名称】　鋼の連続鋳造方法及び設備

(57)【要約】
【課題】　捕捉される気泡、非金属介在物及び鋳片表面偏析、モールドフラックス起因の表面欠陥や内部介在的の少ない鋳片を鋳造して、高品質の金属製品の製造を可能とする。
【解決手段】　鋳型１０の長辺方向に３個以上の電磁石（２８）を配置し、隣り同士の交流コイル２４で発生する磁場を実質反転させることで、溶鋼に位相が実質反転する振動電磁界を作用させ、且つ、直流コイル３４により鋳型の厚み方向に静磁界を重畳することで、局所的な流動を励起させる。



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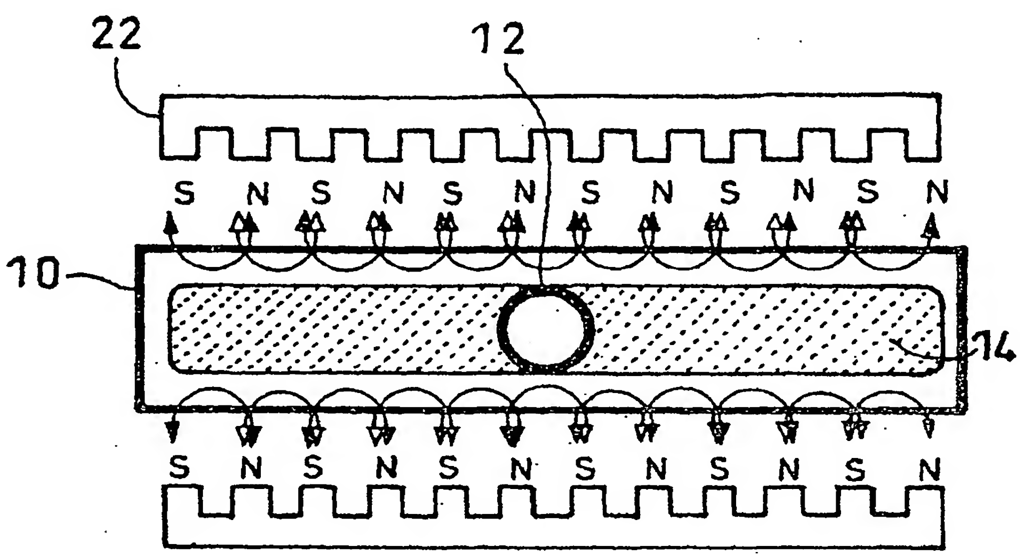
(54) Title: CONTINUOUS CASTING METHOD FOR STEEL

(54) 発明の名称: 鋼の連続鋳造方法



(57) Abstract: Three or more electromagnets are arranged along the direction of the longer sides of a mold, and, while an oscillating magnetic field is being generated, the peak position of the oscillating magnetic field is moved along the direction of the longer sides of the mold.

(57) 要約: 鋳型の長辺方向に沿って３個以上の電磁石を並べ、振動磁界を発生させながら、その振動磁界のピーク位置を鋳型の長辺方向に沿って移動させる。

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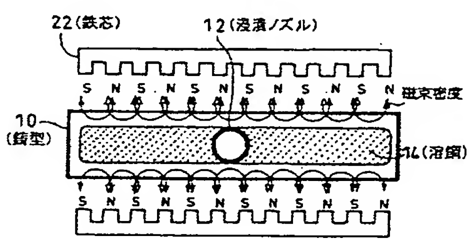
Fターム(参考) 4E004 AA09 MB12 NC01

(54)【発明の名称】鋼の連続鋳造方法

(57)【要約】
【課題】鋳型へ溶鋼を供給するノズルから不活性ガスを吹き込まずに連続鋳造する際、表面欠陥や内部介在物の少ない鋳片を鋳造して、高品質の金属製品の製造を可能とする。
【解決手段】介在物を低融点化した溶鋼が供給される鋳型１０の長辺方向に、３個以上の電磁石（２８）を配置し、隣り同士のコイル２４で発生する磁場を実質反転させることで、溶鋼に位相が実質反転する振動電磁界を作用させ、電磁力によって局所的な流動を誘起させる。
【選択図】　図１



(19) 日本国特許庁 (JP)　(12) 公開特許公報 (A)　(11) 特許出願公開番号
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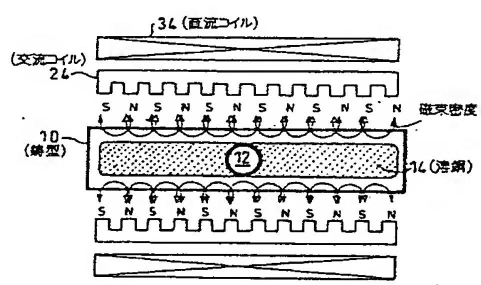
Continued

(54) 【発明の名称】 鋼の連続鋳造方法

(57) 【要約】
【課題】鋳型へ溶鋼を供給するノズルから不活性ガスを吹き込まずに連続鋳造する際、表面欠陥や内部介在物の少ない鋳片を鋳造して、高品質の金属製品の製造を可能とする。
【解決手段】鋳型１０の長辺方向に、３個以上の電磁石（２８）を配置し、隣り同士のコイル２４で発生する磁場を実質反転させることで、溶鋼に位相が実質反転する振動電磁界を作用させ、且つ、直流コイル３４により鋳型厚み方向に静磁界を重畳して、局所的な流動を励起させながら連続鋳造する際、磁場によって駆動されるローレンツ力の最大値を５０００（Ｎ／ｍ³）以上、１３０００（Ｎ／ｍ³）以下にする。
【選択図】　図６



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(22)Date of filing : 11.04.2003

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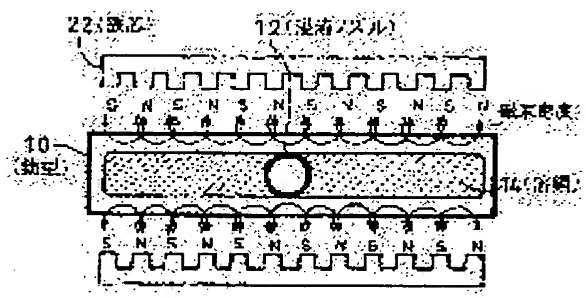
(72)Inventor : MIKI YUJI
TAKEUCHI HIDEJI

(54) CONTINUOUS CASTING METHOD FOR STEEL

(57)Abstract:
PROBLEM TO BE SOLVED: To enable the production of a metallic product of high quality by casting a slab reduced in surface defects and internal inclusions when performing continuous casting without blowing an inert gas from a nozzle feeding molten steel into a mold.
SOLUTION: In the continuous casting method for steel, three or more electromagnets (28) are arranged in the long side direction of a mold 10 fed with molten steel in which the melting point of inclusions is made low, and magnetic fields generated on adjoining coils 24 are substantially inverted, so that vibration electromagnetic fields in which phases are substantially inverted are acted on the molten steel to induce local fluidity by electromagnetic force.



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(71)Applicant : JFE STEEL KK
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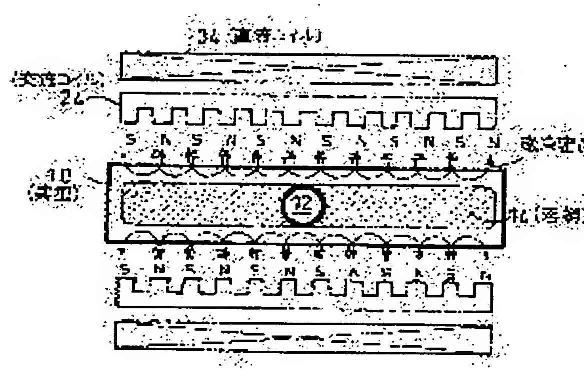
YAMAUCHI AKIRA

(54) CONTINUOUS CASTING METHOD OF STEEL

(57)Abstract:
PROBLEM TO BE SOLVED: To manufacture high quality metallic products by casting slabs having less surface defects and inner inclusions, in continuous casting without blowing inert gases from a nozzle for feeding molten steel to a casting mold.
SOLUTION: Three or more electromagnets (28) are arranged in the major side direction of a casting mold 10 and then, a magnetic field generated by adjacent coils 24 is essentially reversed. As a result, molten steel is actuated by a vibrating electromagnetic field in which a phase is essentially reversed. Also, a stationary magnetic field is superimposed in the thickness direction of the casting mold by a DC coil 34. Thus, in performing continuous casting while fluidity is locally excited, the maximum Lorentz's force driven by the magnetic field is made not less than 5,000 (N/m3) and not more than 13,000 (N/m3).



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[Application Fees]

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[Name of Document] Drawings 1

[Name of Document] Abstract 1

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[Application Fees]

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[Name of Document]	Drawings	1
[Name of Document]	Abstract	1

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[Proof] Required